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ABSTRACT

This paper discusses the difficulties that children with central auditory processing difficulties can have in the classroom environment. Classroom acoustics that can hinder a child's accessibility to instruction are discussed, including open windows or windows not designed to be acoustic barriers, increased reverberation time in rooms with high ceilings, bare floors and walls, and high ambient noise. Soundfield equalization is described as a classroom listening strategy that creates an environment where each child is at a favorable speaker-listener distance by routing the teacher's voice through small, wireless, high-fidelity public address systems self-contained in the classroom. The positive results that students have had in classrooms with soundfield equalization are highlighted. (CR)

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CLASSROOM AMPLIFICATION: NOT JUST FOR THE HEARING IMPAIRED ANYMORE

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"Oh-oh, the teacher's starting to talk again. The other kids are going to get what she's saying but I'm not. I know I'm not going to be able to get it."

He may not say it, even to himself, but that is often how a child with auditory perceptual difficulties feels when he is asked to listen and learn in the classroom. He can probably hear sounds perfectly well, but he can't interpret their meaning. Although his peripheral hearing mechanism functions adequately, his brain does not accurately process auditory messages. Somewhere in the brain's pathways auditory information is garbled, delayed, or blocked. Because the incoming information is confused, the resulting interpretation is also confused.

Simply speaking, Central Auditory Processing is what we do with what we hear. Listening is one of the most important ways we learn. A child with an auditory processing disorder may have trouble learning to speak, read, spell or use language. Faulty auditory perception can cause emotional difficulties that further complicate the problem.

A child's response to these auditory difficulties may take many forms, including withdrawal or he may become hyperactive or distractible. These types of behaviors may be so misleading that the teacher does not suspect an auditory problem.

Classrooms are auditory-verbal environments with listening serving as the cornerstone of the educational system. It has been estimated that 75 percent of the school day is spent engaged in listening activities. Even all our new multimedia technology depends on the child's listening abilities for its successful implementation.

Because of the scarcity of information about auditory learning, few teachers have been trained to recognize auditory deficits. Typically, if a child passes a standard hearing sensitivity test it is assumed he has no auditory difficulty.

It is easy to conclude that in order to do well in school, a child must be able to receive all auditory signals. In the case of students with known hearing loss, we are quick to provide special devices to make the sound audible or to provide special assistance to transform the audible signal into a visual signal. However, we do not usually think about the ability of the average student in the typical classroom to hear the spoken messages. We assume that all the normally hearing students can hear. Unfortunately, we are wrong.

In addition to the children who suffer from Central Auditory Processing Disorders, many children suffer from transient episodes of middle ear infections that create a conductive hearing loss during the infection. It has been estimated that on any given day about 43 percent of primary level children fail a pure-tone screening at 15 dB and/or an immittance screening.

EC 305536

A major problem in a typical classroom is that background noise levels tend to be similar throughout the room but the teacher's speech level at the student's ear gets weaker as the distance between the teacher and student increases. This problem is compounded with students who, in addition, have problems hearing and processing acoustic information even in perfect acoustic environments.

The acoustics of a classroom play a large role in a child's accessibility to instruction. Classroom acoustics are based on three factors: ambient noise level, reverberation time and S/N ratio.

Open windows or windows not designed to be acoustic barriers increase the ambient noise level of a classroom by letting noise from lawn mowers, street traffic or the playground enter the room. Interior ambient noise may include other children, computer equipment, heating system, music and faulty equipment.

Reverberation time (sound echoed off smooth surfaces such as walls or ceilings) increases in rooms with high ceilings, bare floors and walls and reduces a child's ability to hear clearly. Longer reverberation times also reduce the S/N ratio.

According to guidelines set by the American Speech-Language-Hearing Association (ASHA), ambient noise should be no louder than 30-35 dBA in an empty classroom. Reverberation time should not exceed .4 seconds, and S/N ratios should be no lower than +15 db.

However, research shows the average unoccupied noise levels in classrooms at 50 dBA, average reverberation times of .52 seconds, and S/N ratios worse than +4 dB.

Soundfield equalization is a classroom listening strategy that consists of creating an environment where each child is at a favorable speaker-listener distance by routing the teacher's voice through small, wireless, high-fidelity public address systems self-contained in the classroom.

A soundfield equalization system picks up the teacher's voice via a wireless microphone located very close to the teacher's mouth. At this location, the signal is stronger than any noise in the classroom. The signal is then sent to an amplifier that drives loudspeakers that are positioned around the room (usually three or four of them). The amplifier is set and the loudspeakers are positioned to create a positive SNR (approximately +15 dB) in all listening areas of the classroom. This means that the signal is always louder than the noise. In essence, the system puts every student in the front row (acoustically speaking). These systems are often referred to as "soundfield amplification" systems. In reality, the system is not so much an "amplifying" system as it is an "equalizing" system. The system serves to enhance and maintain a positive SNR throughout the classroom. Because "amplification" often implies exclusive use with individuals with hearing loss, and/or that the signal is somehow louder than "normal," the term "soundfield equalization" offers a more accurate description.

A variety of investigators have reported positive findings related to the use of soundfield equalization. Authors have studied various academic and pre-academic behaviors for both students with normal hearing and students with mild hearing losses. The various reports have indicated increases in positive behavior and/or achievement with the use of soundfield equalization systems.

In several reports, teachers have been asked to describe the impact on students and have indicated less distractibility, fewer direction repetitions needed, and more attentiveness.

Results from project MARRS (Mainstream Amplification Resource Room Study) indicated that students in classrooms with soundfield equalization showed significant improvements in Scholastic Reading Achievement scores. This improvement was greater than or at least equal to that experienced by students receiving resource room instruction. In addition, Zabel and Tabor found improved spelling test scores with the use of soundfield equalization.

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